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The Determination of Size Selection of Whiting (*Merlangius merlangus euxinus*) by Square Mesh Panel and Diamond Mesh Codends of Demersal Trawl in the Southern Part of Black Sea

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Abstract

The modification of the trawl codends to reduce the capture of juvenile fish increasing of fishing gear selectivity has been one of the management tools for sustainable fisheries. This study were examined the effect of square mesh escape panel installation on selectivity of demersal trawl codends for whiting (*Merlangius merlangus euxinus*, N.) in the Black Sea. Codend mesh selectivity experiments were carried out using 40 mm nominal diamond mesh PE codend with 36 mm and 40 mm mesh size square mesh escape window inserted in the forward part of the top panel. The experiments were carried out in the southern Black Sea between February and March 2006 on a traditional fishing boat. A total of 6 valid hauls were made by using the hooped covered codend method. Selectivity parameters were calculated by using a logistic equation with the maximum likelihood method. Mean L_{50}s and selection ranges of whiting were determined as 12.57 (se. 0.41) cm and 3.45 (se. 0.03) cm for 40 mm nominal diamond mesh, 12.71 (se. 0.45) cm and 3.12 (se. 0.03) cm for 36 mm square mesh panel and 13.55 (se. 0.32) cm and 3.70 (se. 0.02) cm for 40 mm square mesh panel, respectively. The results shows that the use of square mesh panel (40 mm) in the forward part of the top panel reduce the capture of juvenile fish and increases the demersal trawl codend selectivity.

Keywords: Whiting (*Merlangius merlangus euxinus*), selectivity, square mesh panel, demersal trawl, Black Sea.

Karadeniz'in Güneyinde Kare Gözlü Panel ve Baklava Gözlü Torbaya Sahip Demersal Trol ile Mezgit (*Merlangius merlangus euxinus*) Balığının Boy Seçiciliğinin Belirlenmesi

Özet

Ergin olmayan küçük balıkların yakalanmasını azaltmak için trol torbalarında bazı değişikliklerin yapılması sürdürülebilir balıkçılık için kullanılan yönetim araçlarından biridir. Bu araştırmada mezgit (*Merlangius merlangus euxinus*) balığı için demersal trol torba seçiciliğinde kare gözlü kaçış panelinin etkileri incelenmiştir. Seçicilik denemelerinde trol torbasının üst kısmının ön bölümüne 36 mm ve 40 mm kare gözlü kaçış panelleri yerleştirilmiş ve 40 mm baklava gözlü polietilen torba kullanılmıştır. Araştırma Karadeniz'in güney kıyılarında 2006 yılı Şubat ve Mart ayları arasında ticari balıkçı gemisinde yürütülmüştür. Torba üzerinde çemberli örtü torba yöntemi kullanılarak toplam 6 geçerli ağ çekimi yapılmıştır. Seçicilik parametreleri maksimum benzerlik yöntemi ve lojistik denklem kullanılarak hesaplanmıştır. Mezgit balığının ortalama L_{50} ve seçicilik aralıkları sırasıyla 40 mm baklava gözlü ağ için 12,57 (se. 0,41) cm ve 3,45 (se. 0,03) cm, 36 mm kare gözlü panel için 12,71 (se. 0,45) cm ve 3,12 (se. 0.03) cm, 40 mm kare gözlü panel için 13,55 (se. 0,32) cm and 3,70 (se.0,02) cm olarak belirlenmiştir. Araştırma sonuçları, trol torbasının üst bölümünün ön kısmında kare gözlü panel (40 mm) kullanımının demersal trol torbasının seçiciliğini artırdığını ve yavru mezgit balıklarının yakalanmasının azaldığını göstermektedir.

Anahtar Kelimeler: Mezgit (*Merlangius merlangus euxinus*), seçicilik, kare gözlü ağ panel, demersal trol, Karadeniz

Introduction

With the increasing pressure on fish stocks, it has become more and more important to reduce fishing mortality. One possible mechanism of achieving this is to encourage fishermen to use more selective fishing gears to reduce the dumping or discarding of juvenile fish (Graham and Kynoch, 2001). The use of square-shaped mesh in the codend is one way to increase trawl selectivity (Robertson and Stewart, 1988). To improve the trawl selectivity, many authors have investigated the effects of square

mesh panels and windows on codend selectivity in the past decades. These researches especially focused on bottom trawl fishery (Broadhurst *et al*., 1999). The results indicate that the selective properties of such codends are different from those for diamond mesh codends, and that the 50% retention lengths (L_{50}) for square mesh codends are larger than those for diamond mesh codends of the same nominal mesh size for round ground fish (Stergiou, 1999). Little work has been carried out to establish the selectivity of square mesh panels or codends in the Southern Black Sea of Turkey. Zengin *et al*. (1997) found that for whiting (*M. merlangus*) the square mesh codend was significantly more selective and retained fewer immature fish than the conventional diamond mesh codend. The 36 mm, 40 mm and 44 mm mesh size square mesh codends showed higher selectivity characteristics than the 40 mm size of diamond mesh codend for red mullet (*Mullus barbatus ponticus*) and whiting (*Merlangius merlangus euxinus*) were found in the Middle Black Sea (Özdemir, 2006). Trawl-related discards are generally a result of conventional diamond mesh codends in relation to the minimum landing size (MLS) of the target species, particularly in a multi-species fishery (Graham and Kynoch, 2001). The catch composition of bottom trawl fisheries of the Black Sea comprises of more than ten fish species and the Black Sea has a multi-species fishery characteristic and the bottom trawls used is conventional (Özdemir, 2006). This study investigates the effects of the 36 mm and 40 mm square mesh panel in the conventional bottom trawl gear used in Turkish Black Sea ground fishery for whiting.

Materials and Methods

Experiments were carried out on a commercial fishing boat in the Western Black Sea, between February and March 2006. Water depth of the fishing ground was between 30-80 m. Towing speed varied between 2.2-2.8 knots and towing duration was 90 minutes in all the hauls. Experiments were carried out to investigate the effect of a 150 cm by 280 cm (40 mm mesh size and 36 mm mesh size) square mesh escape window on the selectivity of a 40 mm diamond mesh size PE netting diamond mesh codend. A square mesh escape window made of the same material as the codend was inserted into the front part of its top panel. The position of the window was 50 cm aft to the tunnel codend attachment line and 10 meshes from the sides of the top panel. The method of measuring selectivity was based on the hooped covered codend technique (Wileman *et al*., 1996). The cover was 10 m in length and was made of multifilament polyamide diamond mesh netting of 20 mm mesh size. Two hoops in 3 m diameter supported it. Selectivity parameters of the individual hauls were estimated by means of an MS-Excel file which is run by the "solver" tool (Tokai, 1997). Data were analyzed by using a logistic equation with the maximum likelihood method (Wileman *et al*., 1996). Then, between haul variation was calculated by using ECModel (Con-Stat). The results of the selection analysis for whiting are presented in separate tables (Table 1) giving the estimated parameters v_1 and v_2 of the fitted logistic curves for all individual hauls, and mean curves calculated (Fryer, 1991). The Kruskal-Wallace one way analysis of variance method was used for the mean selection parameters of the three codend types.

Results

A total weight of 255.5 kg fish was caught in codend and cover during 9 hours of trawling in 6 valid hauls. The total catch was composed of 185.5 kg whiting. 50% retention length (L_{50}s) and selection ranges (SR) for all the hauls and mean curve of

Table 1. February and March selectivity parameter estimates for whiting (*Merlangius merlangus euxinus*) in individual hauls with square mesh escape panel installed codend and their mean values. Fifty percent retention lengths (L_{50}), selection ranges (SR), selection factor (SF).

Selectivity Parameters	36 mm Square Mesh Panel			40 mm Square Mesh Panel			40 mm Conventional		
	Feb.	March	Mean	Feb.	March	Mean	Feb.	March	Mean
	Haul 1	Haul 4	Fryer	Haul 2	Haul 5	Fryer	Haul 3	Haul 6	Fryer
v_1	-0.7473	-0.6841	-0,7157	-0,6230	-0,5731	-0,5980	-0,6339	-0,6393	-0,6366
v_2	9.5007	8.6933	9.097	8.5227	7.6975	8.1101	7.9992	8.0045	8.0018
Standard error of v_1	0.33	0.57	0.45	0.20	0.43	0.32	0.43	0.39	0.41
Standard error of v_2	0.02	0.04	0.03	0.01	0.03	0.02	0.03	0.03	0.03
L_{25}	11.24	11.10	11.17 [a]	11.92	11.51	11.71 [b]	10.89	10.80	10.85 [c]
L_{50}	12.71	12.70	12.71 [a]	13.68	13.43	13.55 [b]	12.62	12.51	12.57 [a]
L_{75}	14.18	14.31	14.25 [a]	15.44	15.34	15.39 [b]	14.35	14.23	14.29 [a]
SR	2.93	3.21	3.12 [a]	3.53	3.83	3.70 [b]	3.47	3.43	3.45 [c]
SF	0.35	0.35	0.35 [a]	0.34	0.33	0.34 [a]	0.31	0.31	0.31 [b]
N codend	908	1277	1093	690	1018	854	778	861	820
N cover	2456	2789	2668	3004	3163	3084	1442	1958	1700

Test: a,b,c (→) Differences between groups show with different letter is significant.

window installed codend for whiting were given (Table 1). The mean parameters of the conventional codend from square mesh codends are also given in the table to demonstrate the differences. Mean L_{50}s and SR of whiting were found as 12.57 (se. 0.41) cm and 3.45 (se. 0.03) cm for 40 mm nominal diamond mesh, 12.71 (se. 0.45) cm and 3.12 (se. 0.03) cm for 36 mm square mesh panel and 13.55 (se. 0.32) cm and 3.70 (se. 0.02) cm for 40 mm square mesh panel, respectively. When the L_{50} is compared to those of conventional codends it can be seen that 40 mm square codend increases the L_{50} for whiting by at least 9.3% (Table 1). Although L_{50}s of three codends in February are higher than March, there are significant differences between selectivity parameters of February and March for all the three codends. Figure 1 also demonstrates individual and selection curves and length-frequency distribution of 40 mm conventional 36 mm and 40 mm square codends for whiting in February and March.

Discussion

The large by-catch of undersized fish recorded by demersal trawls, the vast majority of which are subsequently discarded dead, is arguably one of the most serious issues that commercial fishermen and fisheries managers are currently facing. This mortality of immature fish results in smaller future stock sizes and reduced earnings for fishermen (Bullough *et al.*, 2001). The minimum legal mesh size in the codend of trawl nets used in the Black Sea is 40 mm according to Turkish regulations (Anonymous, 2008). But it is impossible to provide sufficiently good selectivity by the use of a single appropriate mesh size for trawl fishery in which the catch is composed of mixed species with different body shapes and sizes (Özbilgin and Tosunoğlu, 2003; Tosunoğlu *et al.*, 2003). There have been only two studies on the comparison of selectivity of square and diamond mesh codends in the Black Sea by Turkish researchers (Zengin *et al.*, 1997; Özdemir, 2006). The use of square mesh panels or escape windows has proven to be successful in several experiments in the Aegean Sea and Mediterranean (Tosunoğlu, 2007; Lucchetti, 2008; Tosunoğlu *et al.*, 2009; Kaykaç *et al.*, 2009; Aydın and Tosunoğlu, 2010). Similarly, this study confirms that the square mesh escape window installation in the forward part of the top panel of conventional trawl codend significantly increases the release of under minimum landing sizes of whiting, according to Turkish Fishery Regulations (Anonymous, 2008). Although the effect of escape window on the L_{50}s is significant for two square mesh panels, it is more expressed for 40 mm than for 36 mm. In conclusion, the present study shows that the installation of a square mesh escape window in the top panel of the conventional trawl codend used in Turkish demersal fisheries significantly reduces the by-catch of immature whiting. However, the 40 mm square mesh codend increases the release of some marketable whiting for which the minimum landing size is 13 cm. In the present study the escape ratio of these fish, in terms of number of individuals is 9.3%. Moreover, better results might be obtained if the window installation is tested and compared for other demersal species in different months, which caught by bottom trawl fisheries in Black Sea.

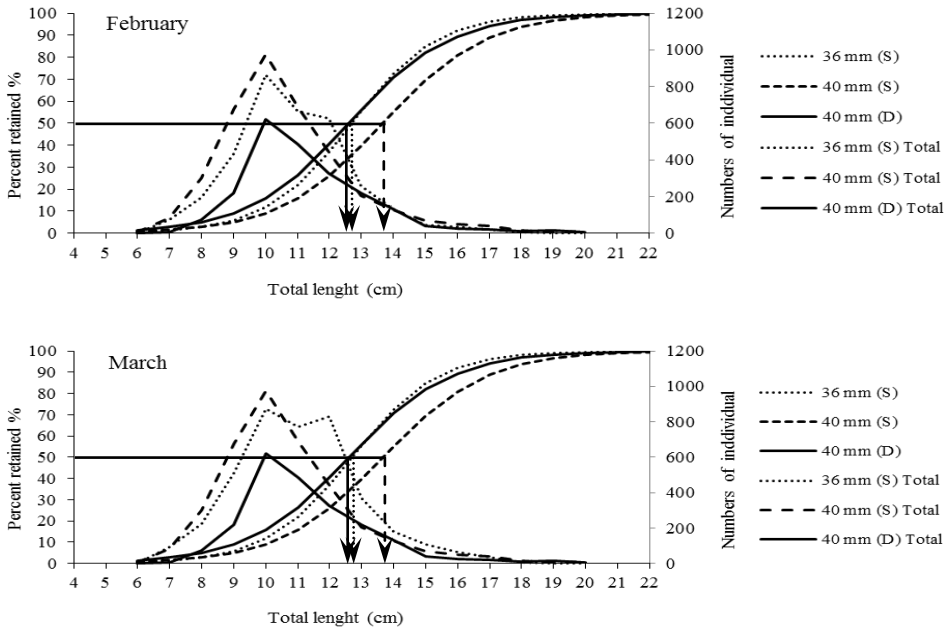

Figure 1. Individual and selection curves for square mesh panel installed codends and conventional codend in February and March. Length-frequency distributions of whiting that entered the codend and escaped are also in the figure.

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References

Anonymous 2008. The commercial fish catching regulations in seas and inland waters for 2008–2010 fishing period: circular No: 2/1. Republic of Turkey, Minister of Agriculture and Rural Affairs, Ankara, Number: 26974. [In Turkish.]

Aydın, C. and Tosunoğlu, Z. 2010. Selectivity of diamond, square and hexagonal mesh codends for Atlantic horse mackerel *Trachurus trachurus*, European hake *Merluccius merluccius* and greater forkbeard *Phycis blennoides* in the eastern Mediterranean. Journal of Applied Ichthyology, 26(1): 71–77. doi: 10.1111/j.1439-0426.2009.01376.x

Broadhurst, M.K., Larsen, R.B., Kennelly, S.J. and McShane, P.E. 1999. Use and success of composite square-mesh codends in reducing bycatch and in improving size-selectivity of prawns in Gulf St. Vincent, South Australia. Fishery Bulletin, 97(3): 434–448.

Bullough, L., Napier, I., Riley, D. and Laurenson, C. 2001. A long-term trial of the effects of a square mesh panel on commercial fish catches. North Atlantic Fisheries College, Fisheries Development Note, No: 9.

Fryer, R.J. 1991. A model of between-haul variation in selectivity. ICES. Journal of Marine Science 48: 281-290. doi:10.1093/icesjms/48.3.281

Graham, N. and Kynoch, R.J. 2001. Square mesh panels in demersal trawls: some data on haddock selectivity in relation to mesh size and position. Fisheries Research, 49: 207–218. doi: 10.1016/S0165-7836(00)00211-3

Kaykaç, H., Tokaç, A. and Özbilgin, H. 2009. Selectivity of commercial, larger mesh and square mesh trawl codends for deep water rose shrimp *Parapenaeus longirostris* (Lucas, 1846) in the Aegean Sea. Scientia Marina 73(3): 597-604. doi: 10.3989/scimar.2009.73n3597

Lucchetti, A. 2008. Comparison of diamond- and square-mesh codends in the hake (*Merluccius merluccius* L. 1758) trawl fishery of the Adriatic Sea (central Mediterranean). Scientia Marina 72(3): 451-460.

Özbilgin, H. and Tosunoğlu, Z. 2003. Comparison of the selectivities of double and single codends. Fisheries Research 63(1): 143-147. doi :10.1016/S0165-7836(03)00005-5

Özdemir S. 2006. The effect of position and mesh size of square mesh panel applied in bottom trawl on catchibility of different species. PhD thesis, Samsun: Ondokuz Mayıs University, Science Institute, Turkey. [In Turkish.]

Robertson, J.H.B. and Stewart, P.A.M. 1988. A comparison of size selection of haddock and whiting by square and diamond mesh codends. Journal du Conseil International pour l'Exploration de la Mer 44: 148-161. DOI:10.1093/icesjms/44.2.148

Stergiou, K.I. 1999. Effects of changes in the size and shape of codend on catch of Aegean Sea fishes. ICES. Journal of Marine Science, 56: 96-102. doi:10.1006/jmsc.1998.0421

Tokai, T. 1997. Maximum likelihood parameter estimates of a mesh selectivity logistic model through SOLVER on MS-Excel. Bulletin of the Japanese Society of Fisheries Oceanography, 61: 288-298.

Tosunoğlu, Z. 2007. Trawl codend design (44 mm diamond PE mesh) and the effect on selectivity for *Pagellus erythrinus* and *Pagellus acarne*, two species with different morphometrics. Journal of Applied to Ichthyology, 23(5): 578–582. doi : 10.1111/j.1439-0426.2007.00859.x

Tosunoğlu, Z., Özbilgin, Y.D. and Özbilgin, H. 2003. Body shape and trawl codend selectivity for nine commercial fish species. Journal of the Marine Biological Association of the UK., 83: 1309-1313. doi: 10.1017/S0025315403008737.

Tosunoğlu, Z., Aydın, C., Salman, A. and Fonseca, P. 2009. Selectivity of diamond, hexagonal and square mesh codends for three commercial cephalopods in the Mediterranean. Fisheries Research, 97: 95–102. doi: 10.1016/j.fishres.2009.01.006

Wileman, D.A., Ferro, R.S.T., Fonteyne, R. and Millar, R.B. 1996. Manual of methods of measuring the selectivity of towed fishing gears. ICES Cooperative Research Report, No. 215.

Zengin, M., Genç, Y. and Tabak, İ. 1997. Determination of the selectivity of bottom trawl. Republic of Turkey, Minister of Agriculture and Rural Affairs, (Project No: TAGEM/IY/96/12/1/004) Report of project, Trabzon, 51 pp. [In Turkish.]